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Taking the "MYSTERY" out of AIR CONDITIONING

Dailaire was one of the first manufacturers to enter the field of Air Conditioning, and having had many years research and development work — as well as a large number of successful installations in homes of all sizes and in commercial applications of all types — we feel that it is now possible for us to give those interested some facts in plain, simple, understandable language that will clear away some of the "mystery" surrounding this term. Primarily this booklet is published, not as a piece of sales literature, but to afford valuable and interesting information.

E J Dail

PRESIDENT DAIL STEEL PRODUCTS CO.
LANSING, MICHIGAN

THE SUBJECT of air conditioning has received widespread attention in popular magazines and news columns during the past four or five years, and is now recognized as a rapidly growing industry. It is one of the most popular subjects of conversation today—but to the average person it is still very vague and confusing. It is a known fact that it has much to do with the improvement of comfort and living conditions, and with safeguarding health, but just what it is, or what elements go into its creation, few realize.

Most people believe that air conditioning is simply cooling the air. THAT IS INCORRECT. If this were the only benefit of air conditioning it would definitely be a luxury, for in most locations the equipment could be used just a few days of the year.

There are two divisions of air conditioning — Summer air conditioning and Winter air conditioning. Some of the functions of each are the same — yet others are entirely opposite. The same basic principles are used in working out the engineering application of both. First, let us impress the reader with the fact that Air Conditioning is a comparatively new engineering science. Satisfactory results can only be accomplished by following certain fundamental physical laws that are as positive as the law of gravitation. Only the engineer who has acquired a complete knowledge of these fundamentals through training and practical application is competent to assume the responsibility of a completely satisfactory air conditioning installation.

The finest home is of little avail if you do not find comfort there. This comfort depends on scientific application of the equipment which is now available. Do not permit some one to experiment at your expense and to your ultimate disappointment. The engineering service which we furnish through our dealers is supervised by men who have college or university training and not less than three to five years practical installation experience.

NATURE PROVIDES DAYS OF IDEAL HEALTH AND COMFORT

We all know that there are many days during the year when we feel the zest of living because the temperature and atmospheric conditions are just right. We vibrate with health and energy, and feel that "its great to be alive." These are ideal comfort days.

What are Ideal Health and Comfort Conditions?

About six years ago a thorough, intensive study was made by the American Society of Heating and Ventilating Engineers in conjunction with the U. S. Department of Public Health to determine the conditions under which individuals "felt complete comfort," or what they termed the comfort zone. They found that the ideal temperature was from 70 to 75 degrees with a humidity content to the air of 40% to 50%, and with a gentle movement of the air. This, we know, checks with the "perfect day" when we feel "just right."

These ideal comfort conditions were reduced to scientific exactness by experiments made earlier by the scientist Paul, of the Institute of Hygiene, Breslau. He placed healthy persons in an air-tight compartment of three cubic meters and kept them there for varying periods up to four hours. First, he kept the temperature and humidity low in this narrow space. The victims noticed no discomfort. Then the scientist upped the temperature and upped the humidity. Discomfort was apparent at once—depression, headache, dizziness, even nausea. Paul admitted fresh air to the victims through a tube. This air was the same temperature and relative humidity of the air in the cabinet. No relief was felt by the "victims."

They occupied a miniature "Blackhole of Calcutta" where, as history records, over 100 persons imprisoned in a hot, humid space approximately fifteen feet square, perished in a few hours from this same inability of the air to draw off body heat. Paul then experimented with various methods of relieving the discomfort of those in the cabinet. First he dried the air, then cooled it and then put it in motion with a fan. He made no chemical change in its content, but the sufferers were almost immediately relieved.

Nature provides many ideal days when we feel the zest of living.

This revolutionary idea of ventilation proved that the discomfort felt by persons in the cabinet was due not to breathing but primarily to inability of air which is too warm, too moist, or too quiet, to carry away body heat.

Air conditioning authorities now agree that perfect comfort for the inhabitants of any enclosed space can only be achieved with a combination of heated or cooled air, with the right percent of humidiy, mixed and properly circulated and distributed.

WHERE AND WHY DO WE FEEL UNCOMFORTABLE?

In order that we may understand why we need air conditioning, we must know what makes us uncomfortable. We know that there are days in Winter when chills "run up and down our back" even though the room thermometer may register 80 degrees. Also we know that in Summer we have days that seem unbearably hot. We look at the thermometer and are surprised that the temperature again is at 80 degrees. In the Winter we were chilly at this temperature, while in the Summer we were nearly suffocating at the exact same temperature. What causes this amazing difference?

HUMAN BODY A HEAT MACHINE

Our bodies are delicately balanced "heat machines". Ten people in an average size room will raise the temperature of that room seven or eight degrees in one hour. Four or five hundred people will raise the temperature in a church or theatre from ten to twelve degrees.

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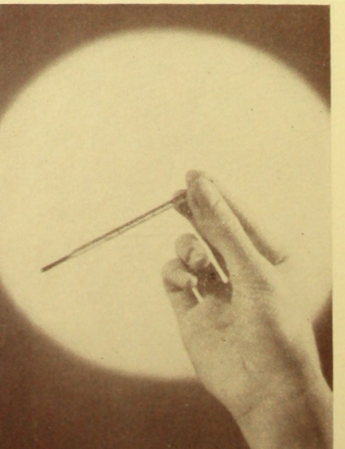
Constant research brings advanced equipment for ideal home conditions.

NATURE'S AUTOMATIC CONTROLS

Nature intended that our bodies be kept at a constant temperature of 98.5 degrees. A rise of only one or two degrees in body temperature is a warning which we call fever. To assist in keeping our bodies at this constant temperature, certain controls or safety valves were provided. One of these is through our respiratory system but the more important one is our perspiration or sweat glands. Under normal heat and proper atmospheric conditions, these glands remove nearly one-fourth of the heat generated by the body. If the air in the room is too dry, the air absorbs the moisture from these glands at such a rapid rate that we feel a chilling sensation. If the air is too heavily laden with moisture, it can not absorb the moisture thrown off by the body which results in a slight raise in the temperature of the body with instant discomfort and a hot, stuffy feeling that is almost unbearable.

TEMPERATURE AND HUMIDITY ARE INTERRELATED

From these simple observations we can understand that comfort depends on having the right balance between temperatures and humidity. In the Summer we can have two rooms, side by side, at the same temperature of 80 degrees. One of them will seem unbearably hot while the other will seem delightfully cool. The one that is unbearably hot will be found, by proper tests, to have a humidity of seventy or seventy-five per cent; the one that is comfortable will have 40 to 45 percent humidity. In Winter, the reverse is true. Two rooms, side by side, both at seventy-five degrees, may not seem to be the same temperature. One with very dry air (15%) will feel cold and the other at the same temperature, but with 45 to 50% humidity, will feel too warm for most persons. In other words, it is desirable in the Summer to have LESS humidity in your home —LESS moisture in the air. The proper amounts should be relative in proportion to the prevailing condition of the temperature outdoors.



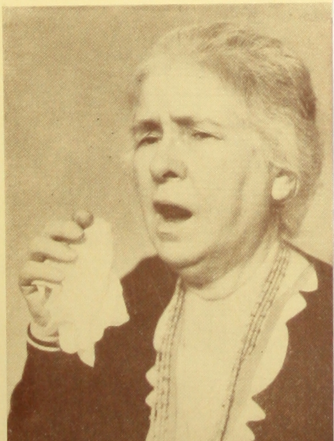
Humidity must be balanced with temperature to realize ideal living conditions.

CONTROL OF HUMIDITY BASED ON FUNDAMENTAL LAW

Every science is based on fundamental laws. Air conditioning is perhaps our newest science and through its development we have applied a law that has been known for many years but never before used for human comfort. This law, simply stated, means that air at different temperatures will hold varying amounts of water.

On a spring or summer morning, we find the lawn covered with dew. During the night, the air was cooled, and with this drop of temperature it could no longer retain the moisture it held when it was warm. This excess moisture collected on the grass in the form of globules that we call dew. When the sun comes up, the air becomes warmer again and the dew disappears because the warmer air can again hold or absorb more water. It is known that air at seventy-five degrees will hold approximately 10 grains of water per cubic foot of air, while air at 10 degrees can only hold less than one grain of water.

If cold, very dry air on a winter day filters in around the windows and doors, (and no window or door can ever be manufactured that won't permit infiltration of air to some extent) and is then heated up to room temperature of seventy degrees — it becomes so dry that it acts like a sponge absorbing moisture from your skin and mucous membranes, making you chilled and uncomfortable because of the rapid evaporation from the skin. The resulting dry condition of your nose and throat retards the removal of germs by natural processes and renders you susceptible to such ailments as colds and influenza which are prevalent in winter months. This dry room atmosphere also sucks up the moisture from our furniture, rugs and draperies in a manner that means constant deterioration. WINTER AIR CONDITIONING IS NOT A LUXURY. It is a NECESSITY in safeguarding your health. It is an actual economy in saving fuel costs. It pre-



Proper humidity and even temperatures reduce common colds.

serves the contents of your home — it preserves the walls and decorations in your home against deterioration. Condition of the air through Winter months, therefore, becomes the most important phase of this new science.

The objective of the air conditioning engineer is to provide a proper balance between temperature and humidity to secure human comfort, to properly cleanse or clean the air from impurities and to distribute the air with a gentle, even flow that will prevent stagnation or drafts.

WINTER AIR CONDITIONING

The four functions of winter air conditioning are:

Heating
Air circulation and distribution
Air cleaning and purification
Humidification

All of which must be under proper control.

HEATING

The selection of a heating plant to secure the highest possible efficiency is of first consideration as we pay fuel bills every season and a slight additional initial cost on a more efficient heating plant can easily be returned in two or three seasons by the saving on fuel costs.

The term heating is understandable by everyone, for it goes without saying that heat in some form is required in most of our states for six or seven months of the year while cooling may be required for only a few days of the year, thus making the matter of winter air conditioning of far greater importance than summer cooling.

EFFICIENT HEATING

Heating engineers universally agree that a warm air heating plant, when properly installed, provides the most economical, most efficient and flexible means of heating that is known. Warm air offers the advantage of QUICK heat during the mild weather. Warm air heat is free from the danger of frozen pipes in cold weather. It is the direct method of transferring fuel into heat and therefore it is the most economical.

Eliminate cold, "drafty" floors with a good air conditioning system.

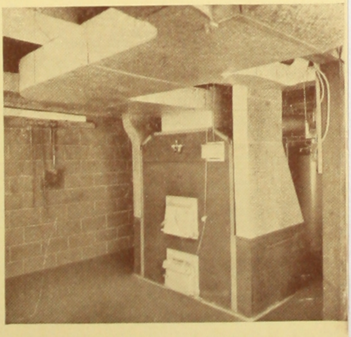
AIR CIRCULATION OR DISTRIBUTION

The advent of the forced air system removed the limitations of gravity heat. Much larger buildings could be heated. All rooms could be heated to a uniform temperature regardless of wind velocities or directions. It greatly increased the efficiency of the furnace because of more rapid heat removal. However, this forced distribution of air involves many engineering problems.

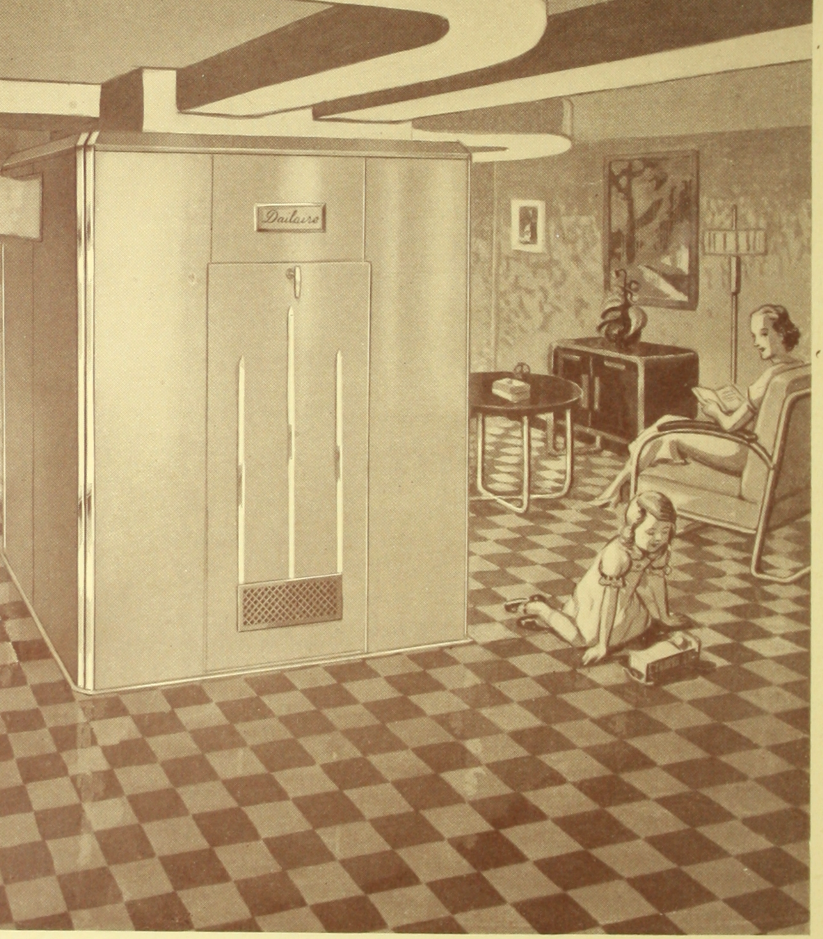
Standards of installation by accredited engineers have established a requirement of five to six air changes per hour in heating. This air must be delivered at an even flow throughout every room with a minimum of noise. The air must be diffused without drafts or stratification or cold spots, all of which demands the consideration of a trained and experienced engineer to secure the best results. Our dealers have this service available through our engineering departments, where they can not provide it themselves.

A well engineered system is worth a lot of money to the owner. The illustration on this page pictures what a well-designed, properly constructed duct system should look like.

To cheapen the Duct or Distribution System by trying to get by with too few ducts, or ducts that are too small or even too large means a poor, improperly balanced installation. There is no short cut method of engineering that can give good results. Even though an installer should build a duct system that was perfect mechanically, the system would be imperfect if the engineer had not properly sized the ducts. So, for a good Air Conditioning system, engineering and good workmanship go hand in hand. It pays to choose the man who knows.



A typical distribution system of a well engineered installaton.



A Dailaire installation transforms the basement from a dusty, dirty, forgotten room into a clean, spacious, **extra** room. Where once stood a dingy, unsightly furnace, now stands the modern Dailaire . . . trim, compact, bright and **clean.** That recreation room you've always wanted . . . that den or workshop for father . . . put them where the "basement" **used** to be

AIR CLEANING AND PURIFICATION

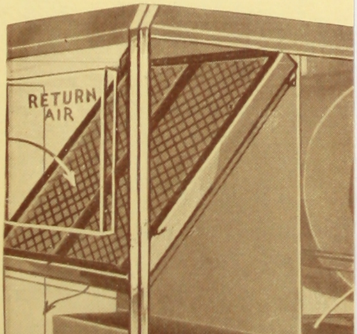
Everyone knows that there is a large amount of dirt and soot in the air because it can be seen . . . you are continually dusting to get rid of it. Measurements have proven that, for every square mile of area, one to five tons of soot are deposited daily in an average city. Every housewife knows the external effect of dust-laden air. The internal effects are more serious. You breathe, each day, more than 400 cubic feet of air. Estimate the amount of polluted foreign matter suspended in the air that has gained entrance to your lungs. This foreign matter includes bacteria and germs which attach themselves to dust particles. Medical authorities realize how dangerous this has become. Dr. Bundesen, Health Commissioner of Chicago, has stated that 60% more people are dying from respiratory ailments caused by contaminated air, than from all other diseases.

METHODS OF AIR CLEANING

Dry Filters

There are two distinct methods of air purification or cleaning. The first and most commonly used is the Dry Filter Process, the air being pulled through filters of spun glass, metal wool, cloth or fibre paper. Most of these filters are very effective in removing foreign matter. However, the filters must be changed frequently to secure desirable results, for, as the filters become loaded with dust, they become less efficient. With the dry filter method it is difficult to secure adequate humidity.

The usual method of securing humidity with warm air heat is to place a pan of water over the hottest part of the furnace. With a fan system, because of the rapid movement of air through the furnace, the temperatures within the casing run much lower than with the old type gravity system. Therefore it is difficult to secure enough evaporation to deliver proper humidity conditions with this method.



Showing Dry Filter location on units — easily removable for replacement.

PRE-HEATED WASHED AIR
Ideal Means of Humidification

The ability of the air to absorb moisture depends on its temperature. The warmer the air, the more water it will carry. Dailaire has developed a special feature whereby the air is first carried over a part of the heating surface and the temperature is raised about 10 degrees before it passes through WATER SPRAYS, thus resulting in proper humidity. Below the spray heads are filters of bronze wool that are kept wet with the sprays and as the air passes through them it becomes completely cleaned and revitalized so that when it is returned to the rooms it is as pure, fresh and clean as the air after a May shower. These sprays are controlled by an instrument known as a Humidistat which can be set for the humidity desired according to outside conditions.

This pre-heating feature also increases the efficiency of the heating system as it holds the air in contact with heated metal twice as long as would otherwise be possible.

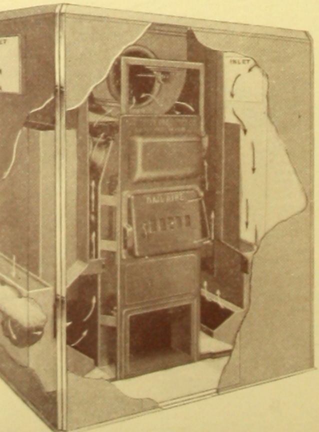
We have now covered the four functions of winter conditioning which, according to engineering authorities, constitute the proper treatment of air for winter health and comfort.

SUMMER AIR CONDITIONING

The four functions of summer conditioning are:

Cooling
De-humidification
Cleaning and Purification
Circulation or Distribution

We will again treat these in the order given above.



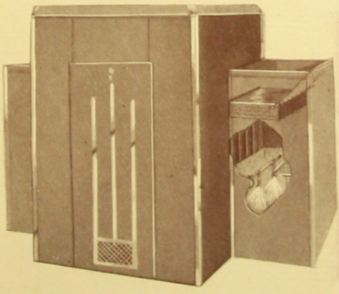
Cut away of front casing of unit showing DeLuxe extended casing which houses oil or gas burner.

DE-HUMIDIFICATION—POSITIVE COOLING

With a winter air conditioning system as described and illustrated on previous pages, it is only necessary to go one step farther to have positive cooling and de-humidification. This necessary step is to add a cooling compartment and evaporator coils. (The Dailaire system is so designed that this can be done at the time of the original installation or added any time later when desired.) We already have the cleaning and air circulating system in the blowers used for winter heating. This type of positive cooling and de-humidification is not too expensive for smaller homes.

HOW IS AIR DE-HUMIDIFIED?

We observe on page 4 that we must remove part of the moisture in summer air to be comfortable. We found on page 5 that if warm, humid air is cooled, part of the water content drops out of the air. This is known as de-humidification. It means simply bringing the temperature down to the "dew" point, which removes part of the humidity. If we take the air out of a room with a temperature of 85 or 90 degrees and pass it over cooling coils through which is circulating water with a temperature of 50 or 55 degrees, the air in passing over the coils will cool down to 60 or 65 degrees. At this point the air can no longer hold the amount of water it held at 85 degrees. Part of the water drops out and this gives us drier air to return to the room we are cooling. With a properly engineered cooling system, the air should be changed eight or ten times per hour for summer cooling, and in the course of an hour's time it may drop the temperature only 5 degrees from where it started. But, what is more important, the humidity has been lowered from 60% or 70% down to 50% and this gives us real comfort because of the cooling effect of rapid evaporation from our bodies. Cooling with water can be accomplished satisfactorily with water up to 60 degrees. Where water is above that temperature, electric refrigeration must be used as the cooling medium. Where water with a temperature of around 55 degrees can be secured, it affords the ideal method of cooling as



Dailaire system showing the addition of cooling cabinets on each side of unit.

This home cooled in summer by using water from the city water systems.

the equipment is much less expensive and the cost of operation is very much less. In many homes, the cooling can be done with the same water that is used for sprinkling the lawn, by simply passing the water through the cooling system, first, thence out into the sprinklers on the lawn.

The above home is that of the president of our company, Mr. E. I. Dail. The first floor of this home has been cooled during the past three summers from water in the city mains, which is from deep wells. The only water used was that used for sprinkling the lawn, except on a few days when there had been showers and no sprinkling was required. The cost of the water for these days was less than $3.00 for the entire season.

Water is the ideal method of cooling, where water can be obtained at less than 60 degrees. In many cases the home owner or small store owner is justified in driving their own well to secure this water supply, rather than pay the higher cost for electric refrigeration.

The third and fourth functions of summer air conditioning — namely, cleaning and circulating — have already been described fully in connection with winter air conditioning. The same distribution system and cleaning process can be used for summer use.

FAN SYSTEM FOR CIRCULATION ONLY

Considerable temporary relief can be secured by operating the fan system on a winter air conditioning system during the hot, sultry days of summer. However, this is only temporary as the cooling effect of basement air is soon lost as it becomes mixed with the other air in the house.

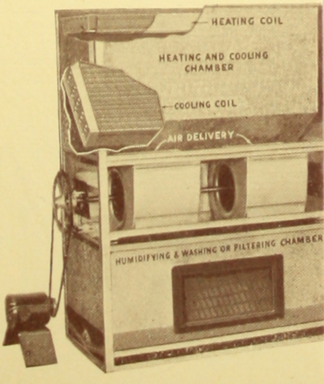
AIR CONDITIONING WITH STEAM OR HOT WATER AS MEDIUM OF HEAT

It has been stated in previous pages that the direct fired, warm air furnaces is the most efficient and most economical form of heating. However, there are many homes already built equipped with steam or hot water boilers. The owners of these homes desire the comforts and health derived from air conditioning and for such homes or buildings we have developed what is known as the Dailaire Split Steam or Hot Water System.

In such systems the second floor — bathrooms — and garages are heated by radiators and the balance of the home heated by warm air, which is produced by passing steam through coils. Ducts for delivering the warm air in winter and cooled air in Summer can be run very easily to all the first floor rooms. The conditioner consists of very efficient copper steam coils through which the blower pulls the air for heating. In the summer, these same coils and blower can be used for cooling. In case electric refrigeration is used, an extra set of cooling coils is required. The necessary humidification is accomplished by sprays which, together with filters, perform the cleaning function.

On the Split System the efficient Dailaire counter-flow principal of air travel is used. The air travels down over the Heating Coils then through the spray humidifier and filters into the blower from which clean humidified circulated air is delivered to all connected rooms. This Split System method of air conditioning is very satisfactory, especially with homes that already have good boilers. New homes should have all forced warm air installations.

The Dailaire Split Steam Conditioner can be furnished in three sizes for cooling or heating or both — Cooling Coils can be furnished for either water or refrigerant cooling as required.


HEATING COIL
HEATING AND COOLING CHAMBER
COOLING COIL
AIR DELIVERY
HUMIDIFYING & WASHING OR FILTERING CHAMBER

Dailaire Conditioners for use with steam or hot water system — this view shows both Heating and Cooling Coils.

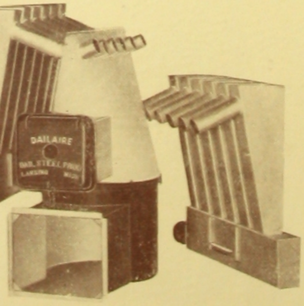
Until five years ago, the heating industry had assumed that oil or gas could be used in the ordinary coal burning furnaces. The development of the Dailaire Special Oil or Gas burning furnace in 1930 marked a new era in automatic heating. At last the time had come when oil or gas heat could be enjoyed at no greater cost than $8.00 coal. Our engineers recognized that the principles of combustion for oil or gas were entirely different than those required for coal. The design of this unit marked greater changes than had taken place in the furnace industry in twenty-five years. The outstanding features of this heating plant are:

ARMCO STAINLESS STEEL COMBUSTION CHAMBER

We were the first manufacturer to make use of that superior metal, Stainless Steel, in the construction of a furnace. This material will withstand 800 degrees more heat than cast iron or ordinary steel. Therefore, thinner material can be used resulting in quicker heat and greater fuel savings in mild weather. Our heating chamber is only 1-16 of an inch thick instead of the usual 1-4 inch in other furnaces, resulting in instant transfer of the heat and also preventing overheating of the rooms when the thermostat shuts off the burner.

DIVIDED FLUES

The efficiency of a warm air furnace is dependent to a very great extent on having a large area of heated metal (called heating surface) for the air to contact and so arranged that there can be free movement of air over this surface. The divided flue arrangement shown provides practically 100% more heating surface than is found on the ordinary furnace of the same size.



Chrome series Dailaire unit with one radiator removed showing Stainless Steel Dome and divided flue.

DAILAIRE OVERHEAD BLOWERS

The blower system of the usual air conditioning system is placed at the bottom of the furnace and pushes the air through the furnace. The Dailaire blower is placed on the top as it requires much less space in the heating room and has the advantage of pulling the air through the heating unit instead of pushing the air, therefore avoiding turbulence and delivering approximately 20% more air from the same size blower. This top blower also distributes the air evenly over every part of the heating surface, avoiding hot spots.

SIZES TO FULFILL THE NEED OF ALL

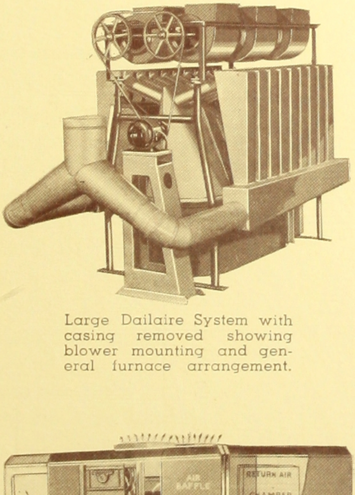
With every home presenting an individual heating problem of its own a well developed line of furnaces must include a range of sizes to meet these varying needs.

You will find Dailaire prepared to fulfill your needs to the letter with a range of sizes capable of delivering from 100,000 to 800,000 BTU per hour with a variety of blower sizes to deliver the required cubic feet of air per minute.

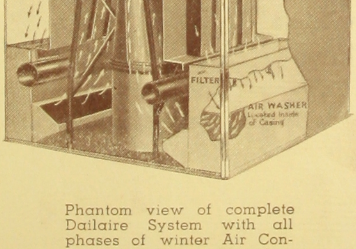
Dailaire also offers a special type Systems for Gas, Oil or Coal, either hand or stoker fired.

ADVANCED FEATURES

To appreciate how Dailaire operates, follow the arrows in the illustration on the right which shows the course taken by the air through the unit. It enters the Return Air Chamber and is preheated as it travels downward over the divided flues—washed and humidified in passing through the sprays — filtered as it travels through the Bronze Filter. It then is drawn upward over the prime heating surface into the blowers where it is forced into all rooms . . . clean, warm, humidified circulated air at a temperature to your liking.



Large Dailaire System with casing removed showing blower mounting and general furnace arrangement.



Phantom view of complete Dailaire System with all phases of winter Air Conditioning within one casing.

IMPORTANT THINGS TO KNOW ABOUT AIR CONDITIONING

1. In addition to controlling and proportioning the six functions involved in air conditioning itself, there are construction factors which must be carefully considered, both in existing and new buildings. One of the most important of these is insulation.

2. A well insulated house can be heated or cooled at a lower cost than those without insulation.

3. In winter, insulation serves to keep the cold out and heat in. In the summer, it keeps heat out and cool air in. Therefore, it is essential in order that air conditioning be economical, that insulation in either new or old buildings should be made as efficient as possible.

4. Awnings on the sunny side of the home or store reduce the cooling load.

5. With windows tightly closed, weather-stripped, or even double or triple glazed, most of the outdoor heat or cold can be shut out. However, in summer when the effort is to keep cool indoors, windows should be shaded; otherwise a good deal of sun heat will come through the glass, with a tendency to raise the indoor temperature or at least to increase the cost of keeping the building comfortably cool.

6. Storm windows or weather stripping reduce your heating load at a resulting lower annual heating cost. Storm windows enable you to carry the desired humidity without frost on the windows.

7. If we go to the expense of installing Air Conditioning equipment, we must not waste the effect of that equipment through carelessly opening doors and windows in summer, any more than we normally do in winter. So far as possible, doors and windows should be kept closed and should be weather stripped. Perhaps some windows can even be sealed. It must be borne in mind that, with the air properly conditioned, there is not the need for the free flow of outdoor air into the building which is felt where Air Conditioning is lacking and necessary air motion supplied by fan.

DAILAIRE

SYSTEM OF HEATING

and

AIR CONDITIONING

by

DAIL STEEL PRODUCTS CO.
Lansing, Michigan